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(54) METHOD OF MANUFACTURING A ROTOR OF AN ELECTRIC GENERATOR

(71) We, TSENTRALNY NAUCHNO-ISSLEDOVATELSKY INSTITUT TEKHNOLOGII I MASHINOSTROENIA, of Sharikopodshipnikovskaya ulitsa 4, Moscow, Union of Soviet Socialist Republics, a Corporation organised and existing under the laws of the Union of Soviet Socialist Republics, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method of manufacturing a rotor of an electric generator.

Normally, the rotor of a four-pole generator with an output of over 1000 MW is so large that it is hardly possible to make it from a solid forging. Such a rotor is commonly made of forgings which, after machining, are joined together either mechanically or by welding.

For example, in a method of manufacturing a rotor, two end members and annular-shaped intermediate members are secured together by means of a threaded central rod screwed into the end members.

However, the rotor of a generator having an output in excess of 1000 MW made by such a method has a reduced strength, rigidity and reliability. The reduced strength of such a rotor results chiefly from the fact that torque is taken by only the friction between the abutting ends of the joined members. The reduced reliability stems from the fact that all the rotor members are held together by only the central threaded rod which has a cross-sectional area one-tenth to one-fifteenth that of the rotor as a whole.

It is known to increase the strength of the rotor somewhat by using through keys or studs as additional interconnections between the rotor members. Sometimes use is made of a number of rods, instead of a single one, for securing the rotor members together, the rods being spaced along the rotor periphery. Yet this method is not suitable for making large-sized two and four-pole rotors since the size and quantity of rods used are limited by the rotor winding slots.

Another method of making generator rotors is known whereby a rotor is made from a number of members welded together. However, as investigations have shown, the fatigue strength (or endurance limit) of welded joints used for high-power generators is rather low as cyclic bending stresses are liable to rise considerably as the rotor size is increased.

The invention provides a method of manufacturing a rotor of an electric generator having two end members and a plurality of annular intermediate members mounted on a stress rod, comprising connecting one of the end members to the stress rod, forming a weld between the said one end member and the adjacent intermediate annular member, and subsequently axially-loading the weld.

Thus it is possible to at least treble the fatigue strength of the weld.

Preferably, the weld is loaded by heating the stress rod to a predetermined temperature and fastening the other end member onto the rod.

Preferably, the stress rod is heated by passing heated fluid through a longitudinal bore in the stress rod.

Preferably, a weld is formed between each of the intermediate members. Members not connected by a weld are connected mechanically.

The invention further provides a rotor of an electric generator comprising two end members and a plurality of annular intermediate members mounted on a stress rod, wherein there is a weld connecting at least an intermediate member and the adjacent end member, which weld was subjected after welding to an axial loading so as to oppose stresses occurring during manufacture and operation of the rotor.

Preferably, adjacent members not connected by a weld are connected mechanically.

Preferably, the members are aligned axially by inter-engaging ridges and recesses on adjacent ends.

The invention will be further described with reference to an embodiment shown by way of example in the accompanying drawings, wherein:—

Fig. 1 is a longitudinal section view of a rotor, and

Fig. 2 is a graphic representation of fatigue strength and applied stress in a welded joint.

In Fig. 1, a rotor comprises two end members 1 and 2, the former being a guide member, and a number of annular intermediate members 3, 4 and 5. Threaded holes 9 and 16 are provided in the end members 1 and 2 into which are inserted the threaded ends of a hollow cylindrical stress rod 7 onto which are fitted the annular intermediate members 3, 4 and 5. During assembly, the end and intermediate members are aligned by means of circular ridges 10, 12 and 13, 15 on the respective intermediate members 3, 4, 5. These ridges engage corresponding circular recesses in the adjacent members. For centering the middle portion of the stress rod 7 an elastic sleeve 18 is provided inside the hole of the intermediate member 4. When all the members have been fitted over the rod 7, the members 1, 3, 4 and 5 are preliminarily heated and welded together at joints 20, 21 and 22, which are subsequently subjected to compression. To effect this hot gas or steam is fed to the hole 6 to pass through the bore of the rod 7 and to escape therefrom through a hole 19 in the end member 2. Upon obtaining the desired temperature difference between the rod 7 and the intermediate members 3 to 5 of the order of 200—300°C the end member 2 is screwed onto the stem 7 as far as it will go, and the supply of gas or steam is stopped. As a result compressive stresses, σ_m, of not less than 10 kg/mm^2 can be established in the welded joints after these have been air-cooled, thus at least trebling the fatigue strength σ_a of a welded joint as shown in the graph of Fig. 2.

When the intermediate member 5 and the end member 2 have cooled down, they are interconnected by means of studs 17 arranged in bores 23 of the end member 2, or by any other conventional mechanical means whose strength is high enough to sustain relatively low stresses that would be imposed upon the adjacent rotor members should the central rod 7 break. Thereupon winding slots are made in the rotor.

As compared with known rotors made by welding, the above-described rotor has welded joints whose fatigue strength is sufficient for most practical purposes to withstand breakage under the effect of lateral stress during prolonged service of the rotor. Furthermore, the harmful effect of possible welding defects is drastically decreased since the effective tensile stresses which contribute to a rapid development of such defects, are counteracted by the compression stresses of the axial loading.

WHAT WE CLAIM IS:—

1. A method of manufacturing a rotor of an electric generator having two end members and a plurality of annular intermediate members mounted on a stress rod, comprising connecting one of the end members to the stress rod, forming a weld between the said one end member and the adjacent intermediate annular member, and subsequently axially-loading the weld.

2. A method as claimed in claim 1, wherein the weld is loaded by heating the stress rod to a predetermined temperature and fastening the other end member onto the rod.

3. A method as claimed in claim 2, wherein the stress rod is heated by passing heated fluid through a longitudinal bore in the stress rod.

4. A method as claimed in claim 1, 2 or 3, comprising forming a weld between each of the intermediate members.

5. A method as claimed in claim 1, 2, 3

or 4, comprising mechanically-connecting adjacent members not connected by a weld.

6. A method of manufacturing a rotor substantially as herein described with reference to the accompanying drawings.

7. A rotor of an electric generator manufactured by a method as claimed in any one of the preceding claims.

8. A rotor of an electric generator comprising two end members and a plurality of annular intermediate members mounted on a stress rod, wherein there is a weld connecting at least an intermediate member and the adjacent end member, which weld was subjected after welding to an axial loading so as to oppose stresses occurring during manufacture and operation of the rotor.

9. A rotor as claimed in claim 8, wherein adjacent members not connected by a weld are connected mechanically.

10. A rotor as claimed in claim 8 or 9, wherein the members are aligned axially by inter-engaging ridges and recesses on adjacent ends.

11. A rotor of an electric generator substantially as herein described with reference to the accompanying drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

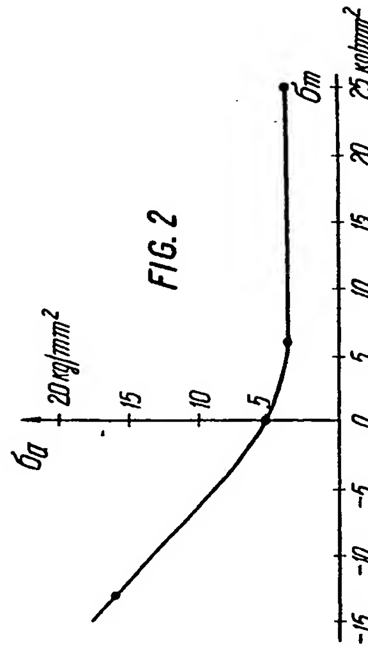

FIG. 2

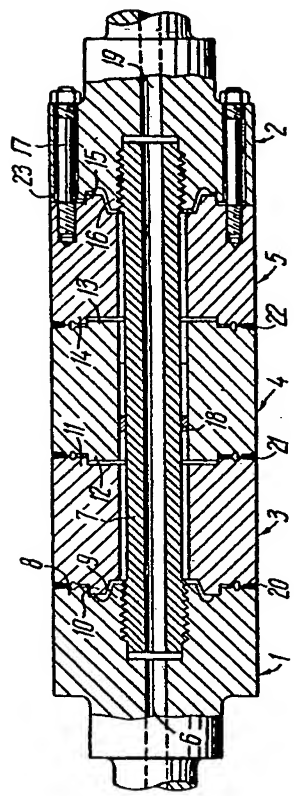

FIG.1